



3rd Annual Parabolic Trough Workshop

Madison Wisconsin
June 18, 2000

Hank Price
SunLab

COLLECTORS, HARPER LAKE, CALIFORNIA

Today's Workshop

Meeting Objectives

- Provide an update on the many developments in parabolic trough solar power technology.
- Obtain feedback from participants on directions for future trough R&D efforts.
- Provide opportunity for information exchange and discussion among participants.

Today's Workshop

Meeting Agenda

Session 1: Trough Technology - Receiver/Concentrator

Session 2: Thermal Storage

Session 3: Plant and Process Design

Lunch: GEF Project Update

Session 4: Modular Trough Systems

Session 5: Trough Program Planning



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3rd Parabolic Trough Workshop

1st Parabolic Trough Workshop

January 1998 - Boulder, Colorado

- No DOE Trough Program
- Industry interest in future project potential
- Four GEF STE projects proposed
- Restructuring of Domestic Power Market
 - California PX opened in April 1998
 - Gasoline ~ 80¢/gallon in Colorado
 - Arizona Solar Portfolio Standard
- Issues:
 - LS-2 vs. LS-3 Collector
 - Direct Steam Generation vs. Heat Transfer Fluid
 - ISCCS vs SEGS

Is there a compelling story for parabolic trough technology?



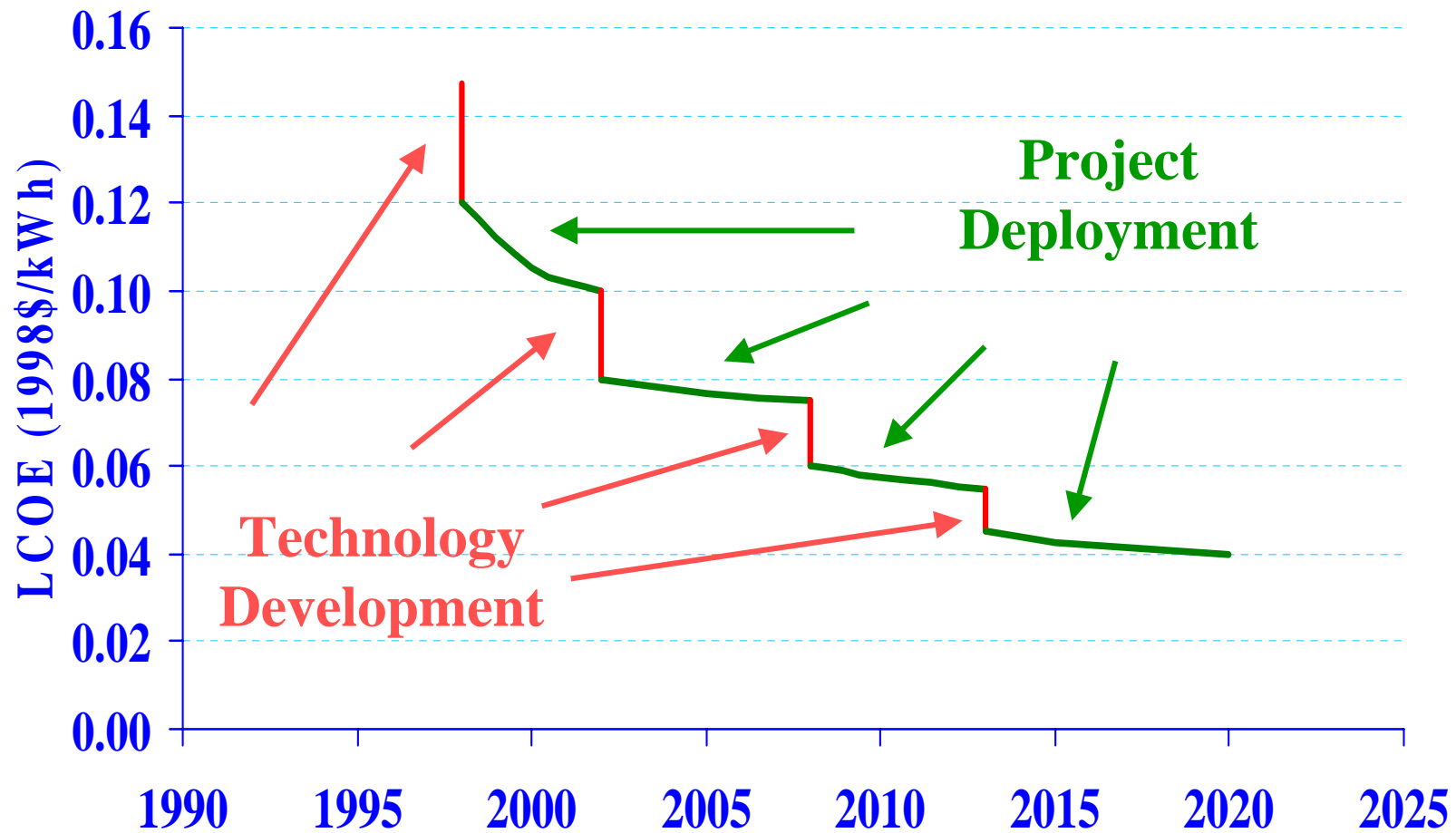
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Trough Roadmap Vision



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3rd Parabolic Trough Workshop

2nd Parabolic Trough Workshop

August 1999 - Ontario, California

- GEF commits \$200M for four STE projects
- Domestic Power Market
 - Average price of power on California PX < 3 ¢/ kWh
 - Gasoline ~ 130 ¢/gallon in California
- Growing industry interest in GEF and Spanish projects
- Issues:
 - ISCCS Crisis in Mathania
 - Thermal Storage for Troughs
 - Receiver Reliability
 - EuroTrough Concentrator Concept
- DOE trough program established and expanding in FY00

What should we be doing?



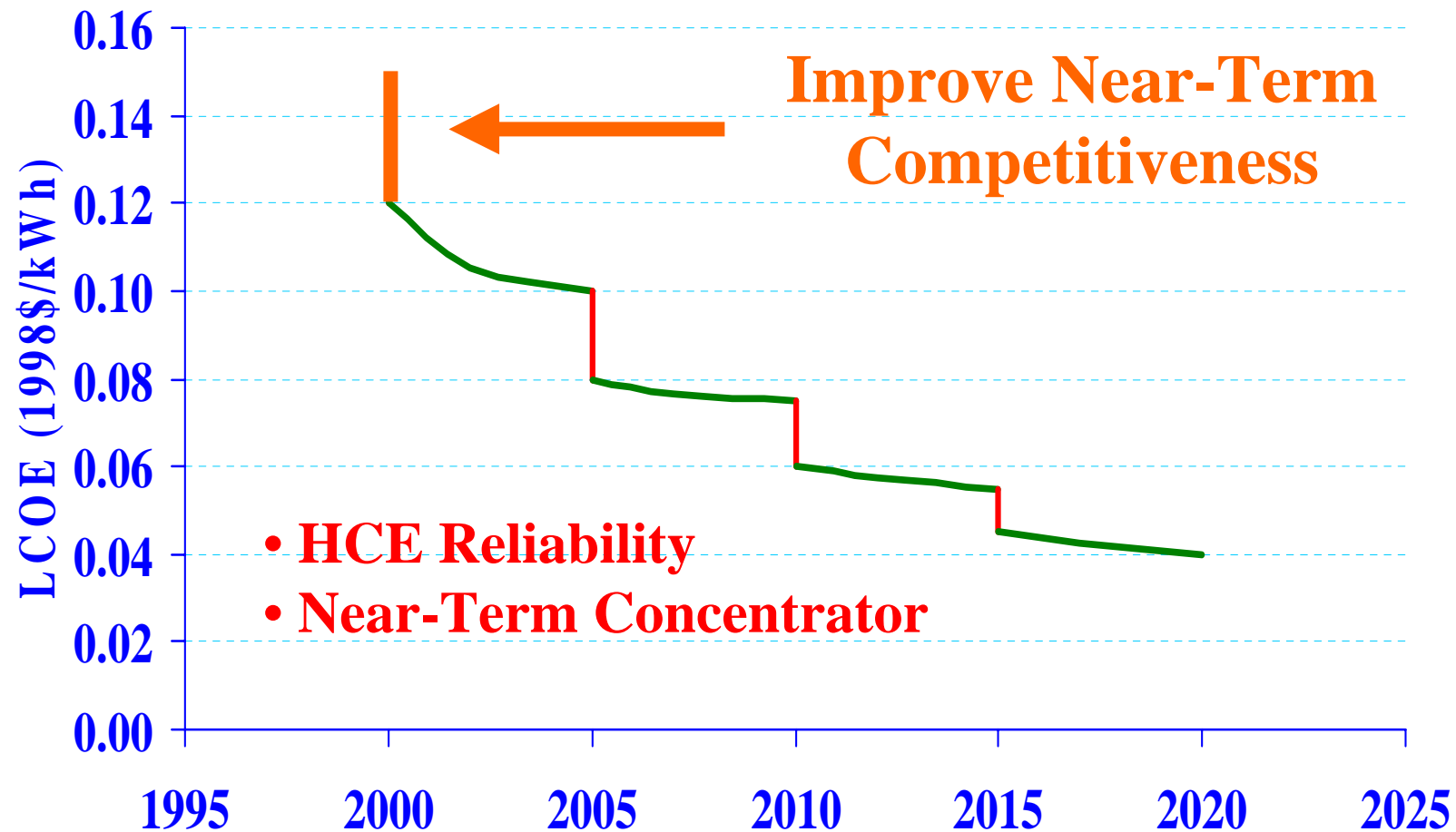
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Trough Roadmap Vision



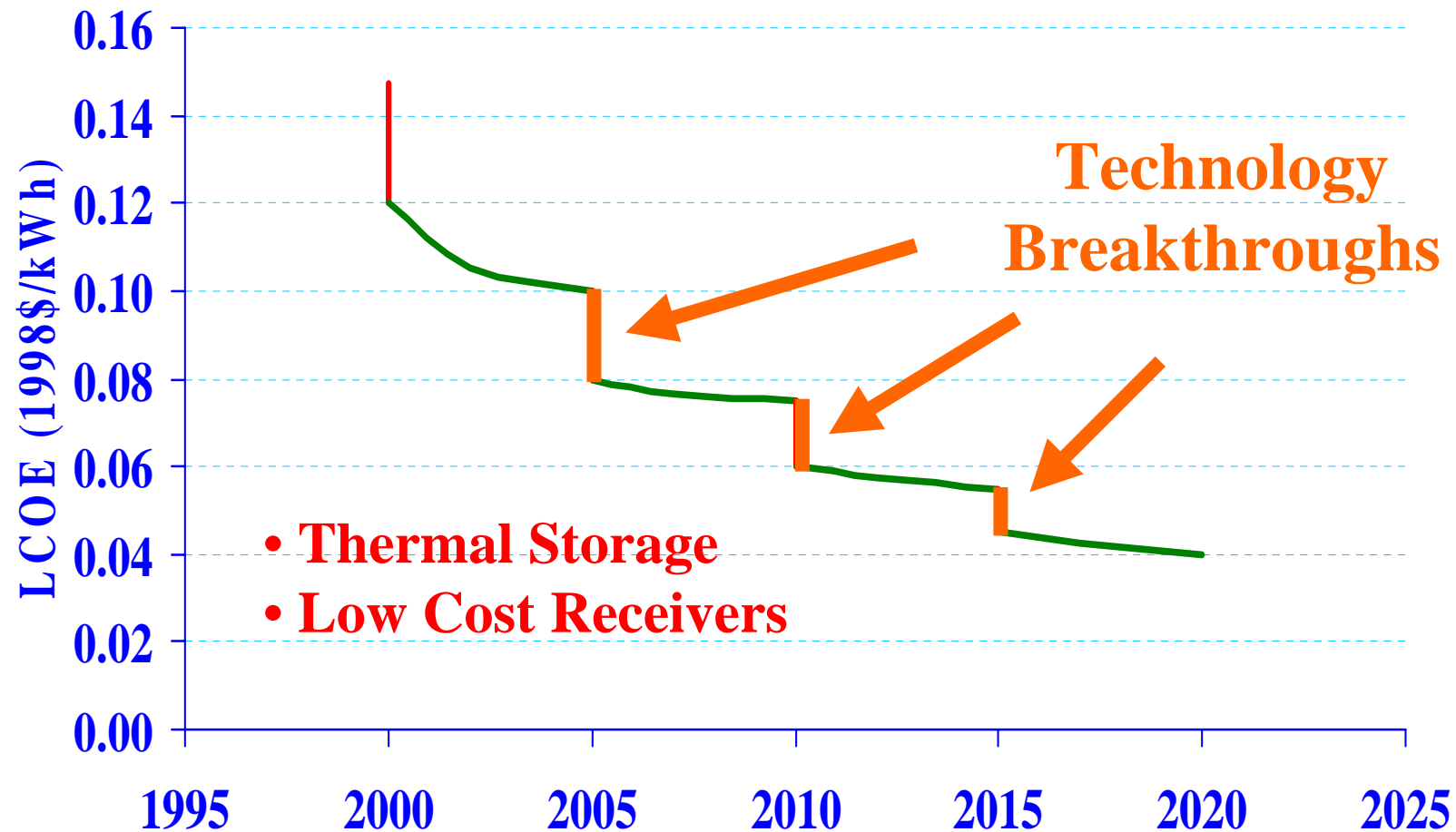
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Trough Roadmap Vision



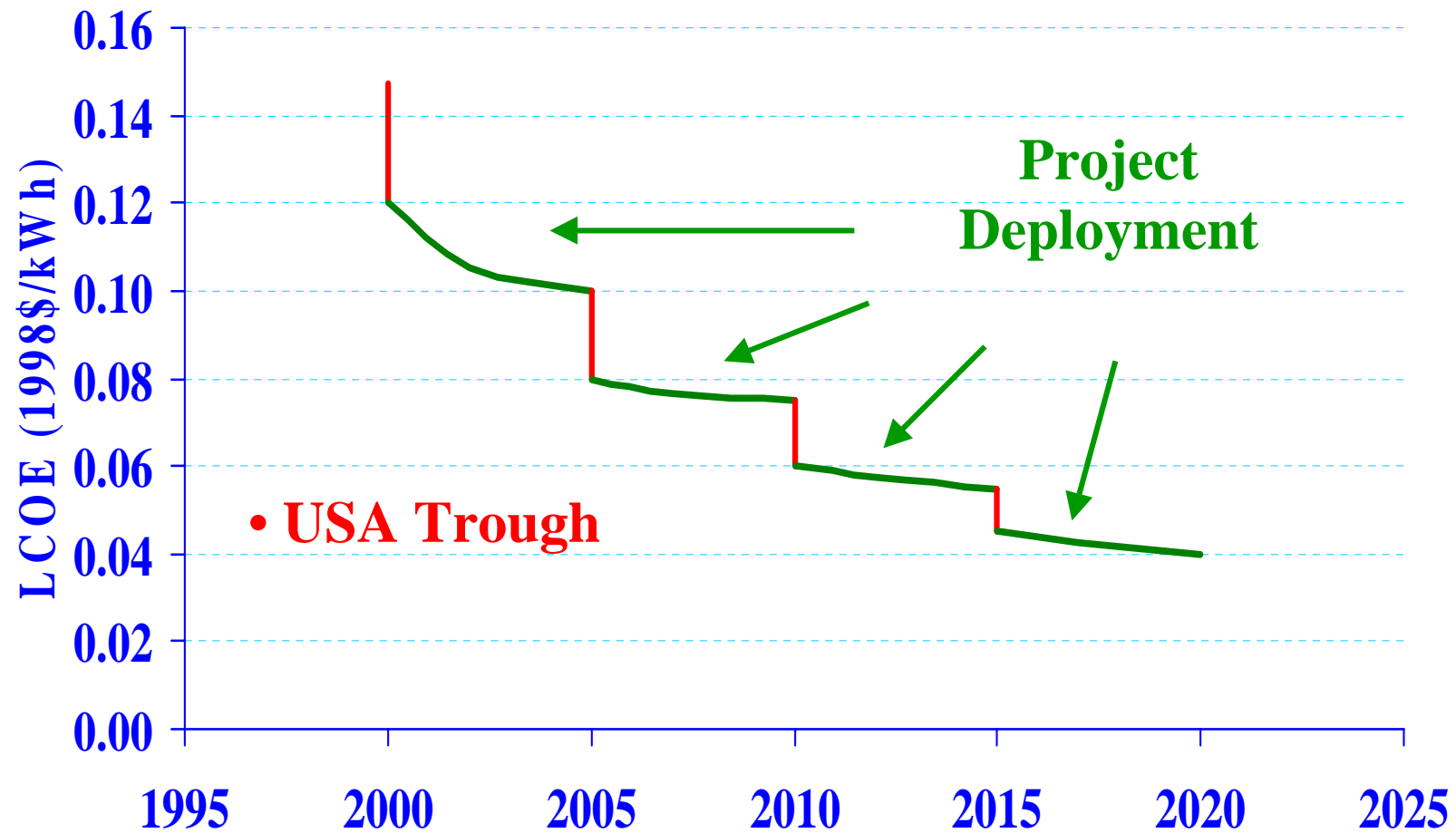
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Trough Roadmap Vision



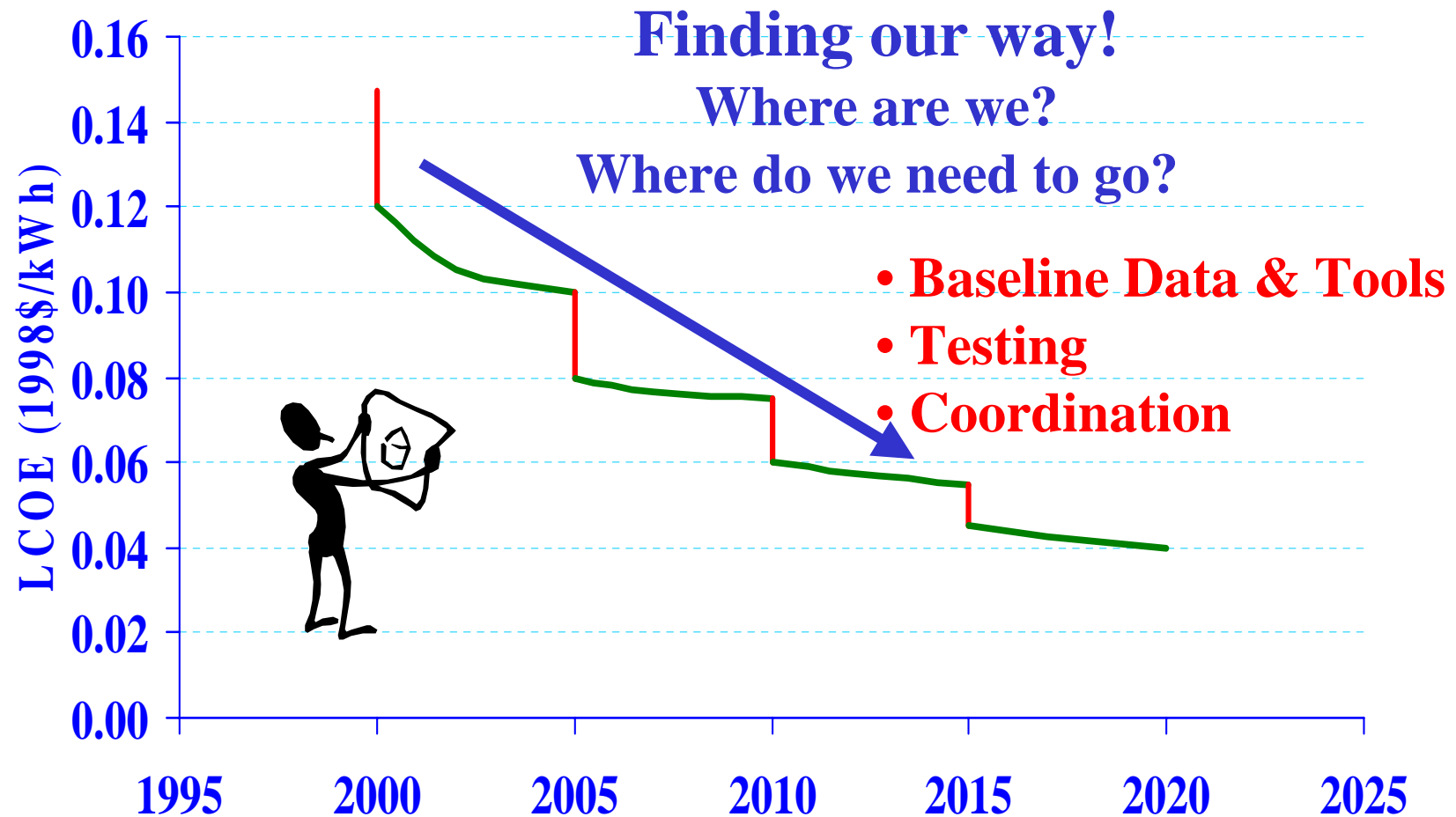
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Trough Roadmap Vision



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FY00 Trough Activities...

2.1 Trough Technology (near-term)

- 2.1.1 Receiver Reliability
- 2.1.2 Concentrator Performance
- 2.1.3 USA Trough
- 2.1.4 O&M Cost Reduction
- 2.1.5 Design Team Coordination
- 2.1.6 Baseline Data

2.2 Trough R&D (long-term)

- 2.2.1 Near-Term Thermal Storage
- 2.2.2 Advanced Thermal Storage
- 2.2.3 High Temperature Selective Coating
- 2.2.4 Low-Cost Receiver Development

USA Trough Phase I - FY99 Awards

Near-Term Trough R&D

- **Reflective Energies**
 - 10 MWe Trough Organic Rankine Cycle Plant
- **Bechtel/Pilkington**
 - High Impact ISCCS Design
 - Thermal Storage for ISCCS and Rankine Trough Plants
- **Duke Solar**
 - Trough Concentrator Development
- **MWe**
 - HCE Reliability Analysis
- **Industrial Solar Technology**
 - Analysis of SEECOT Concept



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USA Trough Phase II - FY00 Awards

Trough R&D

- Reflective Energies
 - ORC Trough Plant Detailed Design (Follow-on)
- Kearney & Associates
 - Assessment of Molten-salt HTF for trough plants
- Duke Solar
 - Trough collector Development (follow-on)
 - Small ORC System Assessment
- Industrial Solar Technology
 - Concentrator Development
- SUNY Albany
 - Satellite DNI Mapping
- Augustyn & Company
 - Improved Low-cost DNI Measurement System

SEGS Testing Partnerships

- **Creates new approach to work with SEGS Plants**
 - Multi-year test and support contracts with each O&M company
 - A framework to cover out-of-pocket expenses for testing
 - Fast turnaround to implement tasks
- **Benefits**
 - Allows testing in commercial plant environment
 - Reduces cost for testing
 - Taps special expertise and resources of O&M companies
 - Provides access to plant specific data



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SEGS Testing Partnerships

- **Testing to be conducted under agreements**
 - Solel UVAC Receiver Test
 - Concentrator performance testing (LS-2, LS-3, EuroTrough)
 - Pilot demonstration of trough thermal storage
 - Power cycle and solar field efficiency testing
- **Status**
 - Testing agreements in place with: Sunray, KJCOC, & FPL Energy
 - Solel UVAC Receiver Test in progress (KJCOC)



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Building SunLab Capabilities

- Models & Tools
 - Receiver Tube Model
 - Ray Tracing
 - Thermal Storage Models
 - TRNSYS for Troughs
 - Spreadsheet Performance Model
 - Alignment Tools for Troughs
- Power Cycle Analysis
 - ORC/Ammonia Water
- Testing capability
 - Thermal Storage
 - SEGS Partnership
- Communications
 - News Letter
 - Web site
 - Workshop
 - Earth Day



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June 2000 - Madison, Wisconsin

- Domestic Power Market
 - Arizona Solar Portfolio
 - Gasoline ~ 190¢/gallon in Wisconsin
- International Power Market
 - GEF projects progressing
 - Spanish market less certain
- Issues:
 - Concentrator Design Approach
 - ORC Trough Power Plants
 - Roles for industry and labs
- DOE trough program budget at risk

What should we be doing different?



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